



MEMO

To: Gerri Caruso
City of Sunnyvale

From: Michael McCormick
Jillian Rich
PMC

Date: November 22, 2010

Re: Community-Wide Greenhouse Gas Emissions Inventory Methodology

This memorandum responds to staff's request for additional information on the City's Community-Wide Greenhouse Gas (GHG) Emissions Inventory (Inventory) prepared by PMC as part of the Climate Action Plan. The following sections outline the methodology and data sources that are included in the Inventory. Please note that some Inventory sources described below, including off-road and stationary source emissions, are in the process of being updated and were not presented to the City as part of the preliminary Inventory results. As always, please contact me at 510-213-7901 with any questions.

Introduction to Greenhouse Gas Emissions Analysis

GHG emissions are calculated by multiplying the amount of activity by the amount of emissions resulting from each unit of activity. For example, if a community consumed 1 million kilowatt-hours (kWh) of electricity and each kWh of electricity results in 0.0004 metric tons (MT) of CO₂, the CO₂ emissions calculation would be as follows:

$$1 \text{ million kWh} * .0004 \text{ MTCO}_2/\text{kWh} = 400 \text{ MTCO}_2$$

The amount of emissions per unit of activity is commonly known as an emissions coefficient or emissions factor. The community-wide inventory uses coefficients for the three primary GHGs (CO₂, CH₄, and N₂O) according to the type and nature of the activity. Activity data is typically provided as energy or water consumed, vehicle miles traveled, or waste generated. The coefficients used for calculating emissions from each activity follow international inventory standards and are utility-, county-, or California-specific, when available.

The three main GHG emissions (CO₂, CH₄, and N₂O) are converted to equivalent carbon dioxide units, or CO₂e. Equalizing the three main GHG emissions as CO₂e allows for the consideration of different GHGs in comparable terms. For example, methane (CH₄) is 21 times more powerful than carbon dioxide on a per weight basis in its capacity to trap heat, so 1 metric ton of methane emissions is converted to 21 metric

tons of carbon dioxide equivalents.¹

Methodology

The City's GHG Inventory is guided by the Bay Area Air Quality Management District (BAAQMD) California Environmental Quality Act (CEQA) Guidelines, adopted in June 2010.² The Guidelines include an appendix entitled Recommended Plan-Level GHG Quantification Guidance. The guidance is recommended for any Plan or program that will be used as a programmatic tiering document under CEQA according to BAAQMD's definition of a Qualified GHG Reduction Strategy.

The Guidelines indicate that the following sources are to be included in any inventory that will be used in a Qualified GHG Reduction Strategy:

- Commercial and Industrial Energy (Natural gas and electricity, including direct access)
- Residential Energy (Natural gas and electricity)
- Transportation (Highway, non-highway)
- Waste (Direct landfill emissions, emissions from community waste)
- Water (Wastewater treatment, energy for filtration and movement)
- Off-road Equipment and Vehicles (Lawn and garden equipment, construction vehicles and equipment)
- Stationary sources (Major industrial point source emissions) – information item only

BAAQMD's guidance is consistent with best practices and international protocol. In absence of a California or national community-wide inventory protocol, it is the best-available methodology for use within the District's boundary.

Data Limitations

Greenhouse gas inventories are a relatively new practice at the local government level. As such, there are some emissions sources for which there is no data available or for which there is no methodology to convert activity to emissions. Lack of available data or methodology prevented the calculation of emissions from the following sources for the following reasons:

- Off-road vehicles and equipment (aside from lawn/garden and construction equipment) – The CARB OFFROAD 2007 software provides emissions from a range of activities. These numbers are aggregated for the entire Santa Clara County area, including incorporated, unincorporated, and state- or federally owned land. BAAQMD has provided guidance on attributing countywide off-road equipment emissions from lawn and garden equipment as well as construction

¹ The potency of a given gas in heating the atmosphere is defined as its global warming potential, or GWP. For more information on GWP, see IPCC Fourth Assessment Report, Working Group I, Chapter 2, Section 2.10.

²<http://www.baaqmd.gov/Divisions/Planning-and-Research/CEQA-GUIDELINES/Updated-CEQA-Guidelines.aspx>

equipment to each jurisdiction, but at this time, there is not a method to disaggregate the remaining data by jurisdiction. Examples of remaining off-road emissions sources include watercrafts, recreational vehicles, and mining equipment.

- Rail (aside from Caltrain) – The federal government does not release information regarding the efficiency, fuel consumption, or mileage of locomotives traveling through Sunnyvale.
- Propane use – Propane is essentially an unregulated fuel in California (except for storage and safety issues, which are regulated). Because it is an unregulated commodity, no data is collected by the State on propane sales or usage.
- Refrigerants – Similar to propane, above, the amount of fugitive refrigerant emissions cannot be calculated because sales are not tracked.
- Lifecycle emissions – For the purposes of local government GHG inventories, there is no standard or methodology for calculating lifecycle emissions. Lifecycle emissions include those from the production, movement, use, and disposal of materials and activities.

The above-mentioned sources are recognized data limitations for local inventories. Many of these sources are available at the state, county, or national level, but cannot accurately be estimated for the City or unincorporated area based on any indicator of activity data.

Activity Data

The activity data used to complete this Inventory came from multiple sources, as summarized in the table below.

Data Sources for Community Analysis, 2008

Sector	Activity Data	Source
Residential	Electricity	PG&E
	Natural Gas	
Commercial/ Industrial	Electricity	PG&E
	Natural Gas	
Transportation	On-Road VMT	Fehr & Peers Transportation Engineers
	Caltrain passenger miles	Caltrain ridership data
Waste	Community Waste (tons)	CalRecycle
	Community Alternative Daily Cover (tons)	CalRecycle
	Direct Landfill Emissions (MMCF)	City of Sunnyvale

Sector	Activity Data	Source
Water	Water consumption	Bay Area Water Supply & Conservation Authority
Off-Road Equipment and Vehicles	Construction fuel consumption and equipment use	California Air Resources Board (CARB) OFFROAD2007 Software
	Lawn and garden fuel consumption and equipment use	
Stationary Sources	Point source emissions	CARB & BAAQMD

Sector Detail: Transportation

On-road daily vehicle miles traveled (VMT) were analyzed by Fehr & Peers, a transportation engineering firm, for the base year of 2008. Fehr & Peers modeled VMT and emissions by speed bin for three types of vehicle trips:

- 1) Vehicle trips with an origin and a destination in Sunnyvale (I-I trips)
- 2) Vehicle trips with either an origin or a destination outside of Sunnyvale (IX-XI trips).
- 3) Vehicle trips with neither an origin nor a destination in Sunnyvale (X-X trips).

As part of SB 375 implementation (see Chapter 1), CARB appointed the Regional Targets Advisory Committee (RTAC) to develop consistent VMT accounting methods for local governments across the state. The RTAC released its recommendation in September 2009. It recommends including 100%, 50%, and 0% of vehicle types 1, 2, and 3 above, respectively. The RTAC methodology is recommended by BAAQMD and by the State.

Sector Detail: Caltrain

Emissions in 2008 from trips taken to or from Sunnyvale by Caltrain are a result of the combustion of diesel fuel on the locomotive fleet. The total number of trips and trip lengths that begin or end in Sunnyvale were determined using 2008 annual weekday Caltrain ridership counts. Weekday trips were summed to determine a weekly and annual number of trips and annual passenger miles traveled to or from Sunnyvale. Total annual passenger miles traveled were multiplied by MTCO_{2e} per passenger mile coefficient. Half of each trip was attributed to Sunnyvale as the other half of the trip would be attributed to the origin or destination outside of the city. Emissions coefficients for locomotives are provided by the Local Government Operations Protocol (LGOP).

Sector Detail: The Built Environment (Residential, Commercial, Industrial)

The built environment comprises residential, commercial, and industrial natural gas and electricity consumption. This Inventory does not include emissions from other types of energy such as propane, solar, and wind due to lack of reliable sales, construction, or consumption data. The commercial and industrial sectors are combined in this Inventory due to the California Public Utilities Commission 15/15 privacy rule. Direct access electricity was not used by any commercial or industrial facilities during the 2008 baseline year.

Sector Detail: Waste

Solid waste emissions are separated into two sources, direct emissions from closed landfills within the city during the baseline year, and future emissions from community-generated waste sent to landfills outside of the city.

- **Direct Landfill Emissions.** Direct landfill emissions include fugitive methane emissions from the City-owned Sunnyvale Landfill located at the northern end of Sunnyvale near the intersection of Borregas Avenue and Caribbean Drive. The City monitors landfill gas at the landfill site on a continuous basis. The California Local Government Operations Protocol developed by the California Air Resources Board (CARB) provides a conversion factor from landfill gas to CO₂e.
- **Community Waste Emissions.** Community waste includes solid waste and alternative daily cover (ADC) produced by the community in 2008 and sent to managed landfills or dumps. Methane generation from waste sent to landfills in 2008 was calculated using the CARB Landfill Emissions Calculator and an average methane recovery or capture factor of 75.0%. The 2004 California Statewide Waste Characterization Study provides standard waste composition for the State of California, which allows the Inventory to account for the different emission rates of various materials.

Sector Detail: Water

Water-related emissions include the electricity use required to convey, treat, distribute, collect, and dispose of water used by residences, businesses, and institutions in the City of Sunnyvale. To clarify, these emissions include those necessary for wastewater treatment. Sunnyvale receives its water from a variety of sources, including the San Francisco Public Utilities Commission (SFPUC), Santa Clara Valley Water district (SCVWD), wells, and recycled water.

Sector Detail: Off-Road Equipment

Off-road equipment emissions for this Inventory are separated into lawn or garden equipment and construction equipment. While other types of off-road equipment, including rail, airport ground services, and recreational equipment, may be used in Sunnyvale, there is not currently a reasonable methodology for attributing the use of these equipment types to an individual jurisdiction, as they are reported at the

countywide level. Construction emissions are attributed to Sunnyvale by determining the proportion of new homes built within the city compared to the total new homes built in the county in 2008. Lawn and garden equipment use in Sunnyvale was determined by the total number of housing units within the city as compared to the county.

Sector Detail: Stationary Sources

Stationary sources are any fixed emitter of air pollutants, such as power plants, petroleum refineries, petrochemical plants, food processing plants, and other heavy industrial sources. Stationary source emissions are monitored and calculated by BAAQMD). At the recommendation of BAAQMD, stationary source emissions are included in the Inventory for informational purposes, but will not be included in the Climate Action Plan. Stationary source emissions are influenced by market forces beyond the City's local control and are best addressed and regulated by the BAAQMD or through federal and state programs.